

transmission rates) have increased, it has become necessary to develop industry standards for higher system bandwidth performance. Systems and installations that began as simple analog telephone service and low speed network systems have now become high speed data systems. As the speeds have increased, so too has the noise.

5

The ANSI/TIA/EIA 568A standard defines electrical performance for systems that utilize the 1 to 100 MHz frequency bandwidth range. Exemplary data systems that utilize the 1-100 MHz frequency bandwidth range include IEEE Token Ring, Ethernet10Base-T and 100Base-T. ANSI/TIA/EIA-568 and the subsequent TSB-36 to TSB-40 standards 10 define five categories, as shown in the following Table, for quantifying the quality of the cable (for example, only Categories 3, 4, and 5 are considered "datagrade UTP").

Table

<u>Category</u>	<u>Characteristic specified up to (MHz)</u>	<u>Various Uses</u>
1	None	Alarm systems and other non-critical applications
2	None	Voice, EIA-232, and other low speed data
3	16	10BASE-T Ethernet, 4-Mbits/s Token Ring, 100BASE-T4, 100VG-AnyLAN, basic rate ISDN. Generally the minimum standard for new installations.
4	20	16-Mbits/s Token Ring. Not widely used.
5	100	TP-PMD, SONet, OC-3 (ATM), 100BASE-TX. The most popular for new data installations.

15 UTP cable standards are also specified in the EIA/TIA-568 Commercial Building Telecommunications Wiring Standard, including the electrical and physical requirements for UTP, STP, coaxial cables, and optical fiber cables. For UTP, the requirements currently include:

- Four individually twisted pairs per cable
- Each pair has a characteristic impedance of 100 Ohms +/- 15% (when measured at frequencies of 1 to 100 MHz)

5

- 24 gauge (0.5106-mm-diameter) or optionally 22 gauge (0.6438 mm diameter) copper conductors are used

Additionally, the ANSI/EIA/TIA-568 standard specifies the color coding, cable 10 diameter, and other electrical characteristics, such as the maximum cross-talk (i.e., how much a signal in one pair interferes with the signal in another pair--through capacitive, inductive, and other types of coupling). Since this functional property is measured as how many decibels (dB) quieter the induced signal is than the original interfering signal, larger numbers reflect better performance.

15 Category 5 cabling systems generally provide adequate NEXT margins to allow for the high NEXT associated with use of present UTP system components. Demands for higher frequencies, more bandwidth and improved systems (e.g., Ethernet 1000Base-T) on UTP cabling, render existing systems and methods unacceptable. The TIA/EIA category 20 6 draft addendum related to new category 6 cabling standards illustrates heightened performance demands. For frequency bandwidths of 1 to 250 MHz, the draft addendum requires the minimum NEXT values at 100 MHz to be -39.9 dB and -33.1dB at 250 MHz for a channel link, and -54 dB at 100MHz and -46 dB at 250 MHz for connecting hardware. Increasing the bandwidth for new category 6 (i.e., from 1 to 100 MHz in 25 category 5 to 1 to 250 MHz in category 6) increases the need to review opportunities for further reducing system noise.

The standard modular jack housing is configured and dimensioned so as to provide maximum compatibility and matability between various manufacturers, e.g., based on the

FCC part 68.500 mechanical dimension. Two types of offsets have been produced from the FCC part 68.500 modular jack housing dimensions.

5 Type one is the standard FCC part 68.500 style for modular jack housing and such standard housing does not add or include any compensation methods to reduce crosstalk noises. The standard modular jack housing utilizes a straightforward design approach and, by alignment of lead frames in a relatively uniform, parallel pattern, high NEXT and FEXT are produced for certain adjacent wire pairs.

10 This type one or standard FCC part 68.500 style of modular jack housing connector is defined by two lead frame section areas. The first section is the mating area for electrical plug contact and section two is the output area of the modular jack housing. Section one aligns the lead frames in a relatively uniform, parallel pattern from lead frame tip to the bend location that enters section two, thus producing high NEXT and FEXT 15 noises. Section two also aligns the lead frames in a relatively uniform, parallel pattern from lead frame bend location to lead frame output, thus producing and allowing additional high NEXT and FEXT noises.

20 There have been approaches that are intended to reduce the crosstalk noises associated with these type one or standard modular jack housings. For example, U.S. Patent No. 5,674,093 to Vaden et al. discloses an electrical connector having an irregular bend in one lead frame of each pair. The irregular bend reduces the parallelism of the lead frames to contribute to reductions in potential coupling effects. Although crosstalk noise 25 may be reduced, forming lead frames as disclosed in the Vaden '093 patent is a complex process and the return loss and differential impedance in the circuit is disadvantageously increased for all four pairs.

The second type of modular jack housing is the standard FCC part 68.500 style for modular jack housings that incorporate compensation methods to reduce crosstalk noises.